Strategy for Designing DSM Program after the Restructuring in Korea

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ABSTRACT

To maintain supply adequacy and mitigate price volatility in electricity market, the necessity for obtaining demand-side resource is increasing and obtaining demand-side resource is set as a priority of electricity policy. For this purpose, we introduce a new DSM mechanism and program development strategies based on customer response and electricity industry efficiency. Especially we introduced DLC(Direct Load Control) technology via two-way communication scheme for large customer. This DLC program targets interruptible load that covers large customer in commercial and industrial sector. This program can retain demand reserve that does not interrupt process in plant or business along with real-time monitoring load condition of end-use and interrupt load by pre-determined procedures, if necessary. This analysis shows that electricity boiler, pump, blower, HVAC can save energy during some time. In addition, developing system to monitor end-use load and interconnecting it with MOS(Market Operation System) should be established as infrastructure in DSM.

1. INTRODUCTION

The DSM(Demand Side Management) program has been administered by KEPCO(Korea Electric Power Corporation) and the Korean government played key role in the program since two oil shocks in 1970s. However, since the restructuring in electricity industry took place in 2000s, KEPCO, a monopoly until now, has been being unbundled and privatized. That is, the generation sector is already separated from KEPCO and in 2003, the distribution and power sales business will be unbundled as well. Post-KEPCO will run transmission business only. Due to restructuring, DSM programs are going through substantial changes in several aspects such as financing, implementation mechanism, designing program, etc.

First of all, funding of DSM programs provided by utility's revenue is being provided by System Benefit Charge(SBC) paid by rate-payers. Due to this, the administrative entity in DSM programs is switched from KEPCO to government. Accordingly, it is necessary to reestablish implementation mechanism and procedures in DSM programs. In the past, under the government's indirect supervision, KEPCO did all the work in areas of management, implementation and evaluation of DSM programs. However, a special organization exclusively managing DSM programs is borne under the actual government's supervision and guidance. And a new measurement & evaluation mechanism is being prepared for evaluating programs and maintaining transparency and objectivity of programs. It is required that the direction and goal of DSM programs should incorporate sustaining reduction of the peak load for preparing electricity supply/demand imbalance and expanding energy efficiency program for energy conservation and environment issues.

Under this background, establishing goal and implementation mechanism of DSM should be preceded and developing effective program and strategy for achieving the above goals become major emerging issues in electricity industry. In particular, since the government wants to maintain adequate DSM resources through DSM investment, it is necessary to develop a new strategy and program based on supply/demand balance analysis reflecting demand resource.

2. DSM before restructuring

2.1. DSM program

The DSM program in Korea has been implemented starting with rebate program in 1974, and seasonal time differentiation rate program in 1977. Since then, in 1980s energy high efficiency technology development was promoted such as electric ballast, compact fluorescent, thermal energy storage system and cooling storage system. In 2001, 3 new programs such as inverter, high efficiency motor, Direct Load Control(DLC) have been implemented.

DSM programs largely consist of load management rebate program, load management equipment program, energy efficiency program and current

Table 1. DSM Status in Korea

DSM Program			Purpose	Applicable Sector
Existing Program	Tariff System	Summer vacation period coordination rate	Peak Load Shedding	Commercial & Industrial customer
		Voluntary Energy Conservation Rate	Peak Load Shedding	Commercial & Industrial, Education
		Load Transfer	Peak Load Shedding	Commercial & Industrial Customer
	Load Management	Cool Storage System	Peak Load Transfer	Commercial & Education Customer
		High Efficient Vending Machines	Peak Load Shedding	Commercial Customer
		Direct Load Control	Peak Load Shedding	Commercial & Industrial Customer
		Remote control Air Conditioner	Peak Load Shedding	Residential & Commercial Customer
	Energy Efficiency	Energy Efficient Lamp	Energy Conservation	Customer Above 6kW Saving
		Energy Efficient Inverter	Energy Conservation	Industrial Customer
	Others	Gas Cooling System	Load Substitute	Commercial Customer
New Program	Load Management	Direct Load Control	Peak Load Shedding	Commercial & Industrial Customer
		Peak Load Management System	Peak Load Shedding	Commercial & Industrial Customer
	Energy Efficiency	Energy Efficient Motor	Energy Saving	Industrial Customer

programs are shown in Table 1.

2.2. Investment

The investment volume in DSM has been increased 1.8times from 33.6 billion won($28 million) in 1995 to 61.5 billion won($50.4 million) and about 140 billion won($117 million) in 2001. Among them, the volume of load management equipment program has been increasing from 14% in 1995 to 30~40% of total DSM investment in 2001.

Table 2. Investment of DSM in Korea

(Unit : 10^8 Won)

DSM Measures		1995	1998	1999	2000	2001
Tariff System	SVPC	66	51	60	150	205
	VCER	14	81	81	71	90
	Load Transfer	8	34	49	5	5
	Sub Total	88	135	146	226	300
Load Manage-ment Tool	Cooling Storage	17	31	36	80	85
	Heat Storage	19	156	253	595	380
	Energy Efficient Vending Machine			14	2	8
	DLC					41
	Remote Control Air conditioner				10	13
	Sub Total	46	187	289	687	527
Energy Efficiency	Lamp	22	71	100	112	124
	Inverter					38
	Sub Total	22	71	100	112	162
R&D/Others		179	222	356	334	411
Total		336	615	890	1360	1400

1) SVPC = Summer vacation period coordination rate program
2) VECR = Voluntary Energy Conservation Rate Program
3) $1 = 1,200won

On the contrary, energy efficiency program accounts for 10% of total DSM programs, which remains relatively at a small scale.

The DSM policy in Korea has focused on load management rather than energy efficiency because the stabilization of supply/demand imbalance through peak load reduction is top priority in energy policy decision-making.

2.3. Performance

In 1990s, due to high growth of peak load, difficulty of power plant financing, emergence of environment and siting issues, the construction of new power plant became difficult. Hence, the target of DSM peak reduction increased gradually. In 1991, the ratio of peak reduction relative to maximum load was about 3.6% and increased to 6.7% in 1995, 11.4% in 2000, and 13.9% in 2001, respectively. The target of load management was 5,981MW in 2001.

Table 3. DSM Performance

(Unit : MW, %)

Items	1993	1995	1997	1999	2000	2001
Capability	24,405	31,968	38,452	43,418	46,078	48,699
Reserve	10.4	7.0	7.3	16.4	12.4	12.9
Demand before DSM	23,234	32,014	39,735	41,900	46,262	49,109
Peak Load After DSM	22,112	29,878	35,851	37,293	41,007	43,125
Peak Reduction By DSM	1,122	2,136	3,884	4,607	5,255	5,981
DSM Performance(%)	4.8	6.7	9.8	11.0	11.4	13.9

Performance by DSM programs is shown in Table 4. The results of peak load reduction show that load management programs such as summer vacation period coordination rate program, tariff structure,

voluntary energy conservation rate account for more than 90% of total peak reduction. As stated above, in the measurement of DSM programs' performance, only peak reduction capacity, MW is verified.

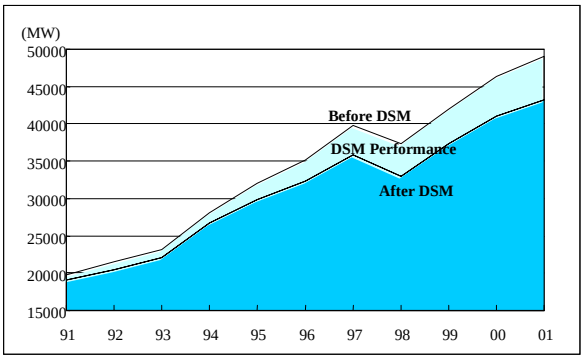


Figure 1. Trends of Peak Load Reduction in Korea

Table 4. Performance by DSM Programs

(Unt : MW)

Year	SVPC	VECR	Cooling Storage System	Energy Efficient Devices	Load Management Rate System	Gas Cooing System	Total
1991	183	-	6	-	389	126	704
1992	316	-	9	-	594	175	1,094
1993	280	-	18	-	594	230	1,122
1994	498	-	29	3	594	287	1,400
1995	653	140	43	15	929	356	2,136
1996	839	388	58	44	1,062	430	2,821
1997	835	698	75	82	1,678	516	3,884
1998	594	993	100	132	1,983	555	4,357
1999	694	987	125	193	1,983	605	4,587
2000	1,069	698	139	258	2,396	695	5,255
2001	1,180	763	185	335	2,644	770	5,891

1) SVPC = Summer vacation period coordination rate program
2) VECR = Voluntary Energy Conservation Rate Program

2.4 Target of DSM

The Korean government reflects the performance of DSM to electricity demand/supply planning made every 2 years. That is, the government overviews performance by programs first and it applies to baseline demand forecast and maximum demand is determined by reflecting the performance of DSM.

DSM programs' target varies in every planning and shows a trend that the ratio of DSM relative to system maximum load is continuously increasing. For example, 5th long-term power development plan established in 2000 had 5 new DSM programs and expanded energy efficiency programs, It targeted 7,430MW of peak reduction compared to 6.460MW in 1998.

Table 5. Goal of DSM in Korea

Long Term Power Plan	Peak Load (MW)		DSM Goal (MW)	DSM Performance Rate (%)	Target Year
	Before DSM	After DSM			
2nd Plan ('91)	-	48,155	1,930	3.4	2006
3rd Plan ('95)	70,852	65,642	5,210	7.4	2010
4th Plan ('98)	76,036	69,572	6,460	8.5	2015
5th Plan ('99)	74,939	67,509	7,430	9.9	2015
Basic Plan ('02)	74,784	67,745	7,039	9.4	2015

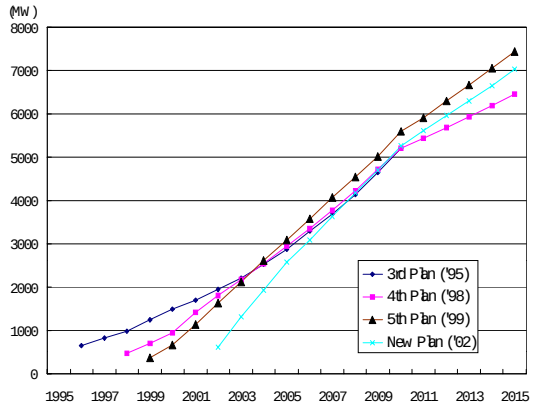


Figure 2. Goal of DSM Activities by Plan

2.5 Investment plan

The Korean government tries to implement load management program effective in supply/demand balance at the beginning of restructuring and expand energy efficiency programs gradually in the future. The introduction of market trading system brings uncertainty of power plant construction, so the government tries to design new program and increase spending on existing programs such as promotion of cooling storage system, direct load control. And at the later stage of restructuring, energy efficiency program benefiting end-user directly will be expanded.

For this, the government plans to spend DSM 117.7 billion won in 2001 and 143.3 billion won increased by 21.7% in 2002. And it also plans DSM investment volume to account for 1% of total electricity sales. DSM programs can be classified largely 5 sub programs. They are load management program, energy efficiency program, rate rebate program, advertising/evaluation, load programs and each program accounts for 33.8%, 21.3%, 25.5%,

4.0%, an d15.3%, respectively. The energy efficiency program volume will be increased gradually in the future.

Table 6. DSM Investment Plan

(Unit : Million Won)

DSM Activities		FY 2002	FY 2003
Load Management		31,902	48,520
	• Cool Storage system	19,345	23,174
	• Direct Load Control	9,307	21,421
	• Remote Control Air Conditioner	3,250	3,725
	• Demonstration	-	200
Energy Efficiency		26,100	30,522
	• Efficient Lamp	16,017	15,197
	• Efficient Vending Machine	682	825
	• Inverter	6,550	9,132
	• Motor	1,394	3,751
	• Demonstration	-	290
	• Audit	1,457	1,327
M&E		3,943	5,700
	• Public Information	2,909	3,500
	• Education	-	500
	• M&E	800	1,000
	• Survey	235	700
Load Management Tariff		34,806	36,625
	• Summer Vacation &Maintenance	22,234	23,510
	• Vuntary Saving	11,995	12,852
	• Load Transfer Discounting	577	263
Loan		21,000	22,000
Total		117,751	143,367

$1 = 1,200Won

3. Direction after the restructuring

3.1 Basic direction

Under the competitive market system, the basic direction for DSM programs is to retain demand resource in the short run, especially focusing on load resource and to sustain energy conservation and prepare for environment issues in the long run. The DSM policy so far was to focus on load reduction. However, it needs to switch to energy efficiency and invest more to energy efficiency programs. But, it is desirable that load management programs should be sustained at the current level for the purpose of continuity of DSM programs.

On the contrary, it is necessary that current DSM programs should be reorganized as government-leading DSM programs and utility-leading DSM programs after the restructuring. In this case, government-leading DSM programs should cover only pure public purpose DSM programs. Distortion of resource allocation should be prevented by prohibiting government from voluntary participating utility/ISO-leading program or market-leading program.

Table 7. Implementation Structure of DSM Program

DSM Program Type	Short Term	Long Term
Energy Efficiency	-Government Initiatives	-Government Initiatives
Load Management	-Government Initiatives	-Government: Reserve : -ISO :System Operating -Supplier : Bidding
Electricity Audit	- Government Support (Electricity Sector)	-MarketTransformation -Supplier : reinforcing Service
Load Management Tariff	- Government Support	-Supplier Initiative (linked with Tariff System)

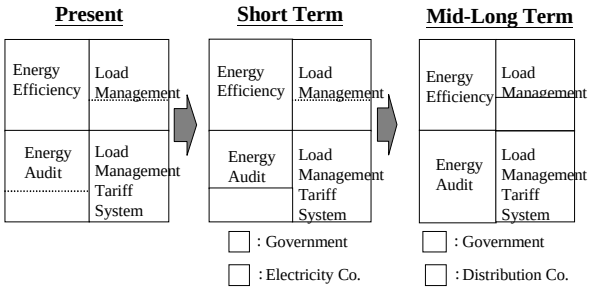


Figure 3. Implementation Structure of DSM Activities

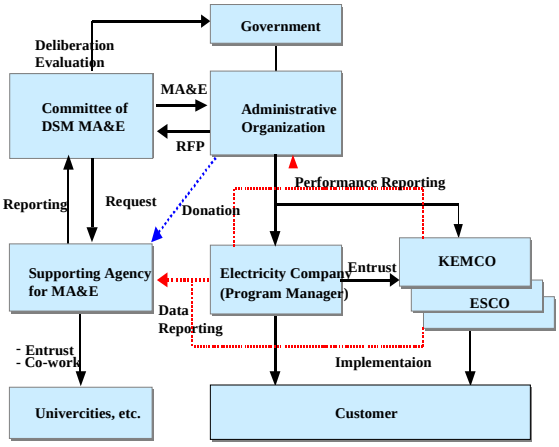
3.2 Implementation mechanism

Implementation mechanism of DSM programs after the restructuring needs to change from duo-structure by government and utility to multilateral structure by government, program manager, evaluation entity, etc. It is absolutely necessary to reestablish DSM implementation mechanism by clarifying functions of DSM programs. It is needed that we may achieve improvement efficiency and objectivity by introducing competitive bidding mechanism in selecting program implementation. Some program administered by KEPCO needs to continue 2~3 more years for smooth transition.

Table 8. DSM Program in the Future (•2003)

DSM Program	Program Purpose	DSM Program
Load Management	- Load shedding and transfer using DSM facilities	- Cooling & Heat Storage Facilities - Direct Load Control etc. on .
Energy Efficiency	- Energy Saving using DSM Measures	- High Efficient Apparatus - Design of Building & Process with Energy Efficiency
Peak Reduction	- Peak Load shedding by Rate Incentives & Subsidy	- Load Management Tariff System - Voluntary Energy Conservation - Load Shedding
Public Information & Education	- Diffusion and promotion of DSM technology through advertising, education, technology support	- Public Information - Education - Energy Audit
MA&E	- Improvement of efficiency of resource allocation and performance of program through M&V	- Method and Procedure Evaluating the Performance of DSM Program - Building DSM DB - Developing Factor and Model

- Governance : MOCIE
- Administration : program manager
- Implementation : utilities
- Assessment: special organization for evaluation and supporting entity (independent organization)



Pigure 4. Implementation Structure of DSM aftet Restructuring

In case of detail classification of DSM by functions, the government determines the DSM policy, funding, establishing target, designing DSM programs and DSM specialist advisory committee support and consult the government in above areas. New funding organization is in charge of program management and each program manager by program administers program. In implementation, programs are divided with competitive and non-competitive sectors. In the former sectors, administrators are selected through bidding process and in the latter sectors, programs are selected through evaluation process of utility's business plan. And, in evaluation process, an independent evaluation entity is established in order to design DSM programs and select administrators and measure & verify DSM performance. It is desirable that the transparency and systemization of DSM M&V would be ensured by establishing an evaluation entity which will perform a function of supporting in evaluation necessary for DSM DB, M&V modeling development.

4. Implementation Strategy of DSM Program

4.1 Contents of DSM program

The contents of DSM are based on objects and program target. First, DSM programs are classified depending on whether it targets load management or energy efficiency and different kinds of measures and promotion policy for same goal. Load management by DSM technology and energy efficiency programs support equipment installation cost through rebate in case of technology chosen. Peak reduction program by end-user response supports can support by compensation or rate discount. Re-classification and coordination of programs by implementer and characteristics are basically required, but partially readjusted based on the existing DSM program classification in short run(~2003).

- new program addition : M&E·M&V program
- program change : peak reduction program, advertising, education program

However, in near-term (after 2003),

comprehensive restructuring of DSM program is necessary based on program type, supporting instrument, program objectives.

- Program design and selection by evaluation system and procedures
- Reflection of demand intention survey such as ESCO, Vender, specialists, etc
- Selection of implementer by competitive bidding mechanism and determination of energy savings goals and investment volume

Table 9. DSM Programs by Sector

Program Purpose	Strategies	Sector
Advancing Existing Program	Promotion and diffusion of high efficiency equipment	Building, multi-family home
	Promotion and diffusion of high efficiency equipment	Industrial customer, large customer
	Introduction of market transformation	Change of support mechanism
	Comprehensive change of load management rate system	Selective contracting method
	Expansion of market participants through standard performance contract	Cost +performance reward
Developing New Program	Small-scale, discriminatory program diversification	Commercial and residential
	Development of efficiency standards of materials and standardization	Supporting program implementer
	Structural change of electricity consumption by conservation-oriented building standard	Lighting, cooling & heating standard
	Conservation program for public building/facility	Link with budget compensation mechanism
	Replacement support program of industrial out-worng facility	Allocation of of performance
Retaining DSM Resources	Voluntary load reduction program	Lump sum Compensation
	Direct load control	Link with system operator
	Selective load interruption	Imposing penalty in case non-compliance
	Retaining reserve program for alleviating load	Alleviating load if necessary
Improving Rule	Construction of DSM infrastructure(DB, modeling, procedure, examine) for performance measure & evaluation	Nursing neutral specialist institute
	Placing mandatory insulating standard for new building construction/retrofit	Insulating window material
	Provision of energy information for energy heavy consumption household	Notice of actual energy usage
Others	Criteria and support system for activation of ESCo, Aggregator	Procedure, volume, contract, etc

4.2 Implementation procedure

4.2.1 Program Selection

List DSM Measure Library based on high possibility of implementation.

- Survey of DSM program and technology/tool used in advanced country
- Classification by customer characteristics and end-use

By technological/economic evaluation standard and procedures, establish DSM programs and priority and select programs based on DSM policy goal and performance.

4.2.2 Supporting Method

It is desirable that the supporting method consists of the following; First, centering on public building, school, public organization, establish DSM incentive mechanism and induce technology diffusion and market at early stage

- provision of energy evaluation support and technology selection for new building
- consultation for retrofit of energy consumption intensive facility

Second, apply the differentiated promotion tool and confirmation method for performance by customer having different pattern, applicable technology.

- providing pre-determined rebate in case of installation of certified high energy-efficiency equipment
- providing compensation per unit with conservation effect for load reduction at energy supply/demand level
- providing fixed price by performance contract for retrofit or replacement of industrial customer
- providing customer-choice on-stop package in new building construction, improvement of process

Table 10. Strategies for Implementing DLC Programs by Objects & Methods

DSM Subject	Program Implement Object	Object				Method			
		Ensure Capacity	Market Stabilization	System Stabilization	Profit-making	Subsidy	Compen-sation	Self-supply (Bidding)	Regulation
ISO	Standing load cutting	•	•			•	•		
	Emergency load shedding		•	•		•	•		
	Retaining system load			•	•			•	•
	Securing supplementary resources			•	•			•	•
Supplier	Peak load shedding				•	•			•
	Retaining emergency resources	•	•					•	•
	Ensuring capacity	•							•
Load Aggregator	Aggregating supply & demand resources				•			•	
	Retaining supplementary resources				•			•	
	Developing new resources				•			•	

Third ; differentiate supporting tools according to program goal, program characteristics, program process stage

- Rebate : development of cost-effective DSM program and early promotion
- Subsidy : provision of rebate for load reduction based on conservation unit(kW)
- Reward for performance : provision of incentive for over-achieving performance contract
- Loan : market diffusion and market transformation
- Rate discount : provision of rate discount for voluntary participation

4.3 Development of Program

It is studied to introduce DLC program for large customer as a tool of compensating electricity supply/demand balance by market function. DLC program is likely to play an appropriate role at the following aspects in electricity market in Korea;

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- Removal of uncertainty following the restructuring and mitigation of electricity supply/demand imbalance
- Compensation of DSM program malfunctioning due to change in market conditions (e.g. load management rebate program, summer vacation rebate program, etc)
- Functioning as a social insurance to prepare for shortage of generation resources

It is possible to design a DLC program in terms of implementer or purpose. For example, Korea Power Exchange can administer DLC program as a tool for cutting standing system peak load and establishing system load and direct load control resource via subsidy or demand bidding mechanism. The entities for implementing DLC program, implementing purposes and methods for obtaining resource are the following.

The current DLC program is administered by KEPCO since 2001. However, from now on, it will be expanded with DSM programs through modification of the DLC program and. The future direction for improving current DLC program is summarized at Table 10.

5. Conclusion

The DSM program in Korea now expects a new administrative system differing from past due to change in electricity trading system, unbundling of electricity business caused by the restructuring of electricity industry.

First of all, it is necessary to change the main role of

the administrator in DSM program from utilities to various entities, i.e. from utilities-oriented in the past to electricity supplier, load aggregator, system operator, government, etc after the restructuring. And, DSM implementation system should be prepared for improvement of efficiency by reinforcing evaluation and verification of DSM programs.

DSM program should be restructured to contribute to mitigate price volatility and supply/demand imbalance in electricity market. In other words, it should be done that utility-oriented program in the past should be reclassified in accordance to implementing entity, purpose and quantified by measuring and verifying previous DSM programs' performance.

In particular, it appears that current existing load management programs will not be valid after the restructuring. Hence, new program such as DLC needs to be developed. The DLC program implementing as a pilot program should be studied more in detail with respect to its purpose and entity. The rational development of demand resource by evaluating DSM potentials of DSM, i.e. demand reserve should be done.

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